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**EXTENSION OF THE WEIGHTED AIRMAN PROMOTION SYSTEM  
TO GRADES E-8 AND E-9**

By

Janos B. Kopyay

**PERSONNEL RESEARCH DIVISION  
Lackland Air Force Base, Texas**

January 1970

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AIR FORCE SYSTEMS COMMAND  
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## **FOREWORD**

**This research was completed under Project 6323, Personnel Management Research and Development; Task 632305, Development of Statistical and Mathematical Procedures to Facilitate Personnel Research.**

**This report has been reviewed and is approved.**

**John G. Dailey, Colonel, USAF  
Commander**

## ABSTRACT

The Weighted Airman Promotion System (WAPS), a system designed and implemented for E-4 through E-7 promotions, was considered for application at the E-8 and E-9 levels. A sample of 1,388 cases was selected from among airmen eligible for promotion to E-8 in the FY 1969 promotion cycle; four career fields in each of four selector aptitude areas were represented. Weighted factors composite scores, including United States Air Force Supervisory Examination, Time-in-Grade, Time-in-Service, Decoration, and Airman Performance Report scores, were computed for all cases in the sample. These composite scores were computed both with and without a Promotion Board score. The derived scores were then rank-ordered to determine the accuracy with which the composite scores predicted the actual promotion outcomes. Although there was some overlap between the predicted and actual promotions, the predictions were not precise enough to encourage operational use of the system with the weights as established in the WAPS. In a series of regression analyses, optimal weights were computed for the same factors. Again, however, the predicted promotions did not correspond sufficiently with the actual promotions to demonstrate feasibility of the system. Further, there was evidence that differential promotion policies were operating in the promotion decisions across career fields. It was concluded, therefore, that a weighted factors promotion system appropriate for use at the E-8 and E-9 levels must include as yet unidentified variables and possibly different equations for various career fields.

## SUMMARY

Koplyay, J.B. *Extension of the weighted airman promotion system to grades E-8 and E-9.* AFHRL-TR-70-2. Lackland AFB, Tex.: Personnel Research Division, Air Force Human Resources Laboratory, January 1970.

### Problem

The Weighted Airman Promotion System (WAPS) was introduced into the Air Force Personnel System in the summer of 1969. This system was designed to provide visible, equitable, and consistent selection criteria for arriving at promotion decisions. Because this is a primary objective in any promotion system, consideration was given to the adequacy of the WAPS for use in promotion beyond the grades for which it was designed, E-4 through E-7, to the supergrades E-8 and E-9. There are, of course, readily observable qualitative differences in the duties of senior and chief master sergeants. Consequently, the same selection criteria incorporated in a system for use at the lower levels might not be adequate for use at the E-8 and E-9 levels. This study was designed to explore that problem. Two basic questions were addressed: First, can the WAPS be applied in E-8 and E-9 promotions with all selection factors weighted as in the system for the lower grades? If not, can the same selection factors, optimally weighted, be incorporated in a system which will be suitable for selection of E-8 and E-9 personnel?

### Approach

The Military Personnel Center provided data cards on airmen who were eligible for promotion to E-8 in the FY 1969 promotion cycle. Four career fields (Communications-Electronics Systems, Aircraft Maintenance, Personnel, and Security Police), representing each of four aptitude areas, were chosen for analysis. The sample included 1,388 cases. The factors included in the weighted factors system were the USAF Supervisory Examination score, a Time-in-Grade score, a Time-in-Service score, a Decoration score, an Airman Performance Report score, and a Promotion Board score. The actual promotion selections served as the measure against which the adequacy of the system was evaluated.

Two sets of composite scores were derived, using weights developed in the earlier WAPS study, one including the promotion board score and the other excluding the board score. Cases for each of the four career fields studied were then arranged in rank-order according to composite scores, and the rankings were compared with the actual promotions for the respective career fields. These comparisons were made to determine the accuracy with which the composite scores, either with or without the board component, identified the individuals who were actually promoted.

An attempt was then made to determine optimal weights for the selection factors which would reproduce as closely as possible the outcomes of the actual promotion board process. A series of statistical analyses were accomplished to provide an estimate of the upper limit of accuracy which might be expected if the weights as determined were applied to other samples. These computations were undertaken to determine how efficiently the selection factors reflected the promotion policies which operated in the board selections.

### Results and Conclusions

Comparison of the rank-orders of the weighted factors scores, both with and without the promotion board component, indicated that inclusion of the board component increased the accuracy of identification of promotion selections over that obtained using the composite score without the board component. Even so, however, the composite score was not precise enough for use. This finding demonstrated fairly conclusively that the WAPS is not directly applicable for E-8 and E-9 promotions.

Results of the efforts to determine optimal weights for the selection factors suggested very strongly that different promotion policies apparently were operating in the actual selections, and that the selection criteria in the weighted factors system did not accurately and consistently reflect the factors considered by the promotion panels. It was concluded that an adequate promotion system for E-8 and E-9 selections will require as yet unidentified variables and, possibly, that differential weighting systems for the various career fields will be required.

This summary was prepared by J.B. Koplyay, Statistical Analysis Branch, Personnel Research Division, Air Force Human Resources Laboratory.

## TABLE OF CONTENTS

	Page
I. Introduction .....	1
II. Approach .....	1
III. Analyses and Results .....	1
IV. Conclusions .....	3
References .....	3
Appendix I: Technical Considerations .....	5
Introduction .....	5
Description of the Sample .....	5
Procedure .....	5
Preliminary Treatment of Data .....	5
Definition of Terms .....	6
Preliminary Analyses .....	7
Predicted Promotions .....	7
Regression Analysis .....	7
Correlational Analysis .....	9
Alternate Systems .....	9
Summary and Conclusions .....	10
Appendix II: Superintendent Air Force Specialties From Which Sample Was Drawn .....	11
Appendix III: Airman Promotion Selection Factors and Points .....	12

## LIST OF TABLES

Table	Page
1 Number of Actual Promotions Compared with Number Predicted by Weighted Factors Composites With and Without Promotion Board Component .....	2
2 Raw Score Regression Weights for the Selection Factors Using Board Score as Criterion .....	3
3 Promotion Percentages for Total Eligible Airmen and Random Samples of Four Specialties for Grade E-8 .....	6
4 Squared Multiple Correlation Coefficients for Weighted Factors Composite Scores Predicting Board Scores .....	8
5 Correlations Between Board Score and Factors of the Weighted Factors Composite .....	9

## FIGURE

Figure	Page
1 Selection factors included in weighted factors systems for airman promotions to grades E-4 through E-7 and grades E-8 and E-9 .....	2

## EXTENSION OF THE WEIGHTED AIRMAN PROMOTION SYSTEM TO GRADES E-8 AND E-9

### I. INTRODUCTION

When the Weighted Airman Promotion System (WAPS) was introduced into the Air Force Personnel System in the summer of 1969, thought was given to the adequacy of the system for use in promotion selections beyond the grades of E-4 through E-7 to the supergrades E-8 and E-9. Because there are readily observable qualitative differences in the duties of senior and chief master sergeants, there was concern that the factor patterns predictive of promotion at lower levels could be adequate for use at E-8 and E-9 levels. This study explored that problem.

As reported by Koplyay (1969a, 1969b), equations developed on a selection cycle for E-5 personnel were field-tested on grades E-4 through E-7. In that study promotion board actions were closely duplicated.

### II. APPROACH

The Military Personnel Center provided data cards for 24,552 E-7 airmen who were eligible for promotion to E-8 in the FY 1969 promotion cycle. Four career fields, representing each of the four selector aptitude indexes, were chosen for the analysis. A specialty was chosen in each aptitude area for which data on more than 250 cases were available. To reduce the workload in manual transcription of non-automated data from the selection folders, a maximum of 350 cases per group was established. Of the nearly fourteen hundred cases chosen, 12 had incomplete data and were dropped. The samples studied were as follows:

AFSC	Career Area	N
30490	Communications- Electronics Systems	340
43290	Aircraft Maintenance	349
73290	Personnel	349
81191	Security Police	350
Total		1,388

Evaluation of the WAPS exactly as used for the lower grades was not possible for E-8 promotions because the Specialty Knowledge Test and Promotion Fitness Examination which are used at lower grades do not exist for persons going beyond the grade of E-7. As a substitute, the score on the USAF Supervisory Examination, which must be passed as a prerequisite for promotion, was used to replace the test scores. Other variables included, in common with the WAPS, were Time-In-Grade (TIG), Time-In-Service (TIS), Decoration (Dec), Airman Performance Report (APR), and Promotion Board scores. Selection for promotion, as reported by Military Personnel Center, was adopted as a criterion measure.

Two basic questions were addressed:

1. Is the WAPS directly useable for E-8 promotions with all variables weighted as in the program for the lower grades?

2. If not, can the same variables available to WAPS be used in a different combination by determining optimal weights which will yield a system suitable for the selection of E-8 and E-9 personnel?

### III. ANALYSIS AND RESULTS

A basic consideration of the WAPS analysis for grades E-4 through E-7 dealt with the necessity for a board score component as a portion of the selection composite score. In that light, optimal composites including and excluding the board score were derived for the analysis. It was found that including the board score did not increase the proportion of persons identified as promotable among those who were actually promoted.

A similar effort was indicated in the E-8 study, so that selection composites for each individual were derived according to the WAPS weights, in one case including the board score; in the other case, excluding it. Figure 1 presents for comparison the variables involved in the E-4 through E-7 study and in the current study.

Selection Factor	Factor Included in System	
	E-4 through E-7	E-8 and E-9
Specialty Knowledge Test Score	X	
Promotion Fitness Exami- nation Score	X	
USAF Supervisory Exami- nation Score		X
Time-in-Service Score	X	X
Time-in-Grade Score	X	X
Decoration Score	X	X
Airman Performance Report Score	X	X
Promotion Board Score	X	X

Fig. 1. Selection factors included in weighted factors systems for airman promotions to grades E-4 through E-7 and grades E-8 and E-9.

When the composite score computations were complete, the cases were arranged in rank-order according to their composite scores including the board score and their composite scores excluding the board score. It was assumed that the promotion quota for the total group was the number promoted in each group. Therefore, that number of cases was taken from the top of each rank-order distribution; the cases within that sample who were actually promoted were described as "overlap" cases. That is, of 340 cases in the Communications-Electronics Systems Career Field (AFSC 30490), 38 were actually promoted. When the cases were arranged in rank-order without the board score, 36 were found to have been promoted. Table 1 shows the number of actual promotions as well as the number for whom promotion was predicted in the composite score distributions. It is apparent that accuracy of identification increased by inclusion of the board score; it is also apparent that even then the composite score was not precise enough for use. It is, therefore, safe to conclude that the WAPS is not directly applicable for E-8 promotions.

An effort was made to determine weighting factors which could be applied to the basic system used for grades E-4 through E-7. In this effort, an attempt was made to use the same variables as were used in the WAPS (except for the substitution of the USAF Supervisory Examination for the Specialty Knowledge Test and the Promotion Fitness Examination), but to find new weights

which would reproduce reasonably well the selection outcomes of the actual promotion board process. A series of multiple regression studies were done, and comparisons were drawn between the specialties involved. The accuracy of ordering based upon the computing sample for a multiple regression problem is an estimate of the upper limit of the accuracy one might expect if the weights are applied to other samples. In this study multiple correlations were derived for all cases in a single sample, and then for each specialty separately. The derived coefficients, reported as squared multiple correlations, were as follows: Total Sample,  $R^2 = .41$ ; 30490,  $R^2 = .61$ ; 43290,  $R^2 = .61$ ; 73293,  $R^2 = .43$ ; 81191,  $R^2 = .57$ . In this form they represent the percentage of variance common to the predictors and to the criterion. It is apparent that the obtained correlations were not of sufficient size to encourage the use of the WAPS variables *per se* for supergrade promotions. A technical discussion of the statistical procedures and the results is presented in Appendix I.

Inspection of the weights determined in the several specialties, as reported in Table 2, suggests very strongly that different promotion policies were operating between the four career fields involved. For example, the Decoration score was heavily weighted for aircraft maintenance personnel but was very slightly weighted for personnel workers. This might suggest that exposure to situations in which decorations are earned is related to specialty, and that decorations are regarded as contributing to promotion of persons who might have opportunity to engage in airborne operations.

Table 1. Number of Actual Promotions Compared with Number Predicted by Weighted Factors Composites With and Without Promotion Board Component

AFSC	Actual Promotions	Predicted Promotions	
		Composite Excluding Board Score	Composite Including Board Score
30490	88	36	57
43290	41	12	15
73293	99	35	53
81191	31	5	12

Table 2. Raw Score Regression Weights for the Selection Factors  
Using Board Score as Criterion

AFSC	Regression Weight for Factor Raw Score				
	Supervisory Examination	Decoration	Time-in- Service	Time-in- Grade	Airman Perform- ance Report
Total Sample	.025	.433	-.240	.037	1.132
30490	.076	.440	-.516	.039	1.740
43290	.003	1.267	.016	.033	.105
73293	.024	.164	-.304	.011	.904
81191	-.004	.380	.447	.056	.842

#### IV. CONCLUSIONS

1. The WAPS, as used for promotion to grades E-4 through E-7, is inappropriate for use at the supergrades E-8 and E-9.

2. Optimal combination of the WAPS variables through multiple regression techniques does not produce composite scores of sufficient accuracy to recommend their operational use.

3. There are differences between prediction equations defining maximum overlap between WAPS variables and E-8 promotion of sufficient magnitude to suggest that a weighted promotion system for E-8 and E-9 will require as yet unidentified variables, and that different equations may be required for various career fields. Additional research in this area is mandatory if a weighted factors system is to be developed for such promotions.

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## APPENDIX I. TECHNICAL CONSIDERATIONS

### INTRODUCTION

Early in 1968, the Personnel Research Division developed a model for an airman promotion system (Koplyay, 1969a). This new system selected eligible airmen for promotion from personal information and scores which are part of each airman's selection folder. The use of these scores was intended to provide objective and visible criteria for selecting airmen for promotion. The system was developed through a policy-capturing exercise conducted at the Division, applying a technique described by Christal (1967). Data on 2,100 E-5 airmen eligible for promotion to E-6 were reviewed by teams of 15 senior personnel officers and 16 senior noncommissioned officers. The mathematical analysis of the results of this experiment provided a "consensus" policy which was expressed in terms of numerical points to be awarded on each factor.

The system was presented for review at the Airman Promotion Conference in Washington, D.C. in April 1968. One question which had remained unresolved was whether or not to include a promotion board component among the other weighted factors in the system. In the interest of insuring the visibility of selection criteria and thus objectivity in promotion, it was the general consensus that the board component should be eliminated if a valid and more visible substitute system could be found and made operational.

Factors comprising the proposed system included Specialty Knowledge Test, Promotion Fitness Examination, Decoration, Time-in-Grade, Time-in-Service, Airman Performance Report, and Promotion Board scores. This new system was field-tested with the cooperation of the Alaskan Air Command for paygrades E-4 through E-7 in the FY 1969-B promotion cycle. Since the prior promotion system had been based primarily upon promotion board decisions, the retention or elimination of a promotion board component in this new system was one of the major research interests. The field test served the purpose of answering two basic questions:

1. Should promotion boards be retained or eliminated?
2. To what extent does the new system duplicate promotion/non-promotion outcomes when promotion board scores are excluded from the system?

The findings for these questions (Koplyay, 1969a, 1969b) indicated that inclusion of a promotion board component in the weighted factors system did not significantly affect the predictive efficiency of the system. Further, the new system without the board component was highly valid in predicting promotion/non-promotion outcomes for grades E-4 through E-7 within the specialties analyzed in the study.

Extension of these findings to a promotion system for E-8 and E-9 personnel was the objective of the present study.

### Description of the Sample

The Military Personnel Center provided 24,552 data cards on E-7 airmen eligible for promotion to E-8 in the FY 1969 promotion cycle. After excluding duplicate records and cases for which no matching USAF Supervisory Examination scores were available, 24,052 usable records were retained. To insure a sample of sufficient size to permit separate analyses within Control Air Force Specialties, it was decided that only those specialties with 250 or more cases would be considered. Appendix II lists the specialties and shows numbers of cases included in each. The four career areas chosen for the study were Aircraft Maintenance (AFSC 43290), Personnel (AFSC 73293), Security Police (AFSC 81191), and Communications-Electronics Systems (AFSC 30490). This selection provided one career field in each of the selector aptitude indexes (i.e., the Mechanical, Administrative, General, and Electronics aptitude areas as defined by the Airman Qualifying Examination or other required aptitude measures). To reduce the workload involved in manually transcribing data from selection folders, the number of cases within these groups was restricted to 350 maximum per group. The 1,400 cases were selected randomly. During the initial phase of the study, 12 cases were excluded for reasons of incomplete data.

### PROCEDURE

#### Preliminary Treatment of Data

The following factor scores were obtained:

1. *USAF Supervisory Examination (USAFSE) score.* Obtained from Personnel Research Division files.

2. *Time-in-Service (TIS) score.* Computed using difference between Total Active Federal Military Service Date, extracted from selection folders, and 1 December 1969.

3. *Time-in-Grade (TIG) score.* Computed using difference between Date of Rank, extracted from selection folder, and 1 December 1969.

4. *Decoration (Dec) score.* Computed by the Military Personnel Center from selection folder data and reported to the Personnel Research Division in roster form.

5. *Airman Performance Report (APR) score.* Computed by multiplying the overall evaluation mean by fifteen. This mean was based on reports for a five-year period prior to the eligibility date, not to exceed ten reports.

6. *Promotion Board score.* Computed by multiplying the total board score for each airman by five. All selection panels were composed of three members; the maximum total board score from a panel was 30 before conversion. The upper limit of the board score variable was 150.

The list of selectees was obtained from the Military Personnel Center, and a promotion action variable- 1 if promoted, 0 otherwise - was added to each record.

To test for the nature of the sample selection, promotion percentages of the random sample were compared with promotion percentages of the total group within each specialty in the study. Table 3, which summarizes this comparison, indicates that the percentage of promotion for the random sample agreed very closely with the promotion percentage for the total group of eligible airmen in the given four specialties.

Table 3. Promotion Percentages for Total Eligible Airmen and Random Samples of Four Specialties for Grade E-8

AFSC	Percent Promoted	
	Total Eligible	Random Sample
30490	23.06	25.89
43290	11.48	11.75
73293	22.88	28.28
81191	10.18	8.86

## Definition of Terms

Terms used in this study are defined as follows:

1. *Promotion Quota.* The number of airmen in the sample selected for promotion within a given specialty is considered the promotion quota. For example, the promotion quota for the Communications-Electronics Systems Career Field (AFSC 30490) was 88; that is, 88 of the 340 cases analyzed were actually selected for promotion during the 1969 promotion cycle.

2. *Predicted Promotion.* If a weighted factors system were used as the basis for promotion selections, the individuals whose scores are within the range of highest scores determined by the promotion quota would be selected for promotion. Thus, if an individual's score on the proposed weighted factors composite places him near the top of his competitive group, he would be predicted for promotion in preference to another individual whose score is nearer the bottom of that group. This hypothetical promotion selection, then, is a predicted promotion.

3. *Promotion Cutoff (Score).* The cutoff is the score achieved by that individual whose rank-order is equal to the promotion quota for his Air Force Specialty.

4. *Promotion Overlap.* If a composite variable were used to order individuals in terms of promotion preference, some individuals with ranks at or better than the promotion cutoff would be promoted by the operational system, while others with scores above the promotion cutoff might not be selected for promotion. The promotion overlap is the number of cases falling at or above the promotion cutoff who are actually selected for promotion. The more nearly the overlap equals the promotion quota, the greater the correspondence between the operational system and a substitute system which uses a composite variable as the basis for promotion selections.

5. *Percent Promotion Overlap.* This term refers to the ratio between the number of individuals predicted for promotion by a particular composite variable and the actual number of promotions for that specialty (i.e., the promotion quota).

6. *Alternate Composite.* This term refers to a weighted factors composite score with weights or factors different from the those proposed for this study for grades E-8 and E-9.

### Preliminary Analyses

Although there was conclusive evidence that addition of a promotion board component to the weighted factors system for grades E-4 through E-7 changed very little the promotion/non-promotion outcomes for eligible airmen, it was necessary to analyze the effects of a board component added to the weighted factors system for grades E-8 and E-9 as a first step in this study.

Weighted factors composite scores were computed for each airman in the study by adding the relevant factor scores in two ways: first, by including the promotion board component and, then, by excluding this component. This procedure resulted in two composite scores for each airman: a Weighted Factors Score Including Board Component and a Weighted Factors Score Excluding Board Component.

Next, airmen were ranked on these two composite scores. The highest ranking position, indicated by the lowest numerical rank value, was assigned to the highest score. Thus, the highest, or best, rank would be associated with the highest composite score and the lowest numerical rank value.

### Predicted Promotions

Since the actual promotion actions were known at the time of the analysis, a comparison of predicted *versus* actual promotion was easily accomplished. Airmen with ranks equal to or better than the promotion quota for their specialty were identified and counted to establish the number of airmen within this "better-rank" group who were actually promoted. For example, for the Communications-Electronics Systems Career Field (AFSC 30490), the promotion quota was 88. After the airmen in this group were ranked on the Weighted Factors Score Excluding Board Component, 36 airmen out of the 88 best scores were found to have actually been promoted. The implication is that 52 airmen were ranked "incorrectly" by the weighted factors score if the rankings made by the promotion board can be assumed to valid.

Table 1, in the report, indicates the number of actual promotions (in effect, the promotion quota) and the number of cases for which the rank on the Weighted Factors Score Excluding Board Component was equal to or better than the promotion cutoff.

Application of the frequencies in Table 1 as cell entries in a contingency table resulted in a chi-square value of 87.02 with 3 degrees of freedom,

which is statistically significant beyond the .001 level of confidence. That is, differences as large as those observed between actual promotions and promotions predicted by the weighted factors score could happen by chance less than 1 out of 1,000 times. In short, it can be safely concluded that the Weighted Factors Score Excluding Board Component would not have promoted the same individuals who were promoted by the existing board system and that this failure of duplicating the promotion/non-promotion outcomes was statistically significant.

The next analysis was similar to the one just described except that the Weighted Factors Score Including Board Component was used to rank-order the airmen within each specialty. Table 1 also shows the actual promotions and the number of airmen whose rank on the Weighted Factors Score Including Board Component was equal to or better than the number of promotions for their specialty. Although there was a marked increase in the number of predicted promotions (i.e., airmen with ranks on the Weighted Factors Score Including Board Component equal to or greater than the promotion cutoff), the chi-square value of 41.02 with 3 degrees of freedom was significant beyond the .001 level of confidence. In other words, the Weighted Factors Score Including Board Component still would have failed to promote the individuals who were selected by the existing board system, even if the board component (which in fact served as the sole selection criterion within each Air Force Specialty) had been included as a component in the composite score.

The implication is that weighted factors scores, with weights as used in the promotion study for grades E-4 through E-7, introduce a sizable error component in the promotion prediction when these scores are added to the board score (i.e., the original selection criterion) to form a composite variable for selection purposes for grade E-8.

Before proceeding with additional analyses it was necessary to make one basic assumption, namely that the selection outcomes based upon the present board evaluation system provide the Air Force with an optimal set of promotion/non-promotion decisions. This was an operating assumption for the purpose of this study only.

### Regression Analysis

The current analyses demonstrated that the weighted factors system with or without a board component failed to duplicate promotion/non-

promotion outcomes for grade E-8 when the weights of the factors remained the same as those developed for grades E-4 through E-7. This is not surprising since the weights were the result of a policy-capturing analysis using a grade E-5 population; the weights so developed were not expected to be directly applicable to the supergrades E-8 and E-9.

Since the originally developed weights resulted in composite scores which failed to duplicate promotion/non-promotion actions, it was necessary to seek a set of optimum weights. To develop the new weighting system, another policy-capturing analysis was necessary, using a sample of promotion-eligible airmen in grades E-8 and E-9.

A brief explanation of the term *weight* may be helpful at this point. Any composite score implies a sum of two or more scores of one kind or another. These scores may be test scores or points assigned for length of military service, performance rating, decorations, or any other so-called factor which is part of a scoring system resulting in one numerical value, or composite score. A weight in a system like this represents the number by which the score on an individual factor of the composite system is multiplied before the scores of the factors are added together. Thus, a composite score is a sum of several subscores, each multiplied by its designated weight. The procedure used to determine these weights is commonly known as regression analysis (Bottenberg & Ward, 1963). Explicitly, the combination of weights sets the upper limit of the predictive efficiency of a prediction system.

The weights, of course, do not have to be, and seldom are, whole numbers. From the mathematician's point of view, the problem of weighting is solved once these values are found. In practice, however, a constraint must be imposed on this weighting system so that the weight applied to a factor will result in an integer number which will be easily interpretable to the given population.

Table 2, in the text, summarizes the weights obtained by regression analysis for the factors of the proposed weighted factors system for the total sample and for each specialty. These weights represent the best possible combination of values by which each factor in the prediction system should be multiplied to achieve maximum efficiency in predicting promotion board actions.

It is clear from the results shown in Table 2 that the weights computed for the total sample differ from those computed for each specialty. It

is also clear that weights computed for the specialties differ among themselves as well. There are some similarities, however. The Time-in-Service scores have negative weights for the total sample and for two of the four specialties analyzed. Also, the weights for the USAF Supervisory Examination appear to be very small and even negative in one specialty (AFSC 81191).

At the beginning of this section, reference was made to the fact that regression analysis provides weights which, when applied to the subscores, set the upper limit of the predictive efficiency of the system. This upper limit, expressed in terms of the variance accounted for in the system, is indicated by a squared multiple correlation coefficient ( $R^2$ ). The higher this coefficient, the more variance is accounted for by the prediction system. The value of  $R^2$  ranges between zero and unity. An  $R^2$  of 1 implies that the system accounts for all the variance reflected in score differences.

The purpose of the regression analysis in this study was to establish the amount of explained variance when optimal weights are used. Table 4 gives these squared multiple correlation coefficients for the total sample and for each specialty. The results shown in the table indicate that the explainable variance in the prediction system ranged between 40 percent ( $R^2 = .39614$ ) and 61 percent ( $R^2 = .61373$ ). For the total sample, only 41 percent ( $R^2 = .40775$ ) of the variance was accounted for by the system. This, of course, implies that 59 percent of the variation in scores came from sources undetected and unknown to the prediction system. It is again noted that these values are optimal, or best possible, outcomes; to explain 41 percent of the variance, it would be necessary to use the weights shown in Table 2.

The relatively low  $R^2$  values imply that the promotion board score reflected the use of other information in the selection folder besides the data incorporated in the proposed weighted factors system.

Table 4. Squared Multiple Correlation Coefficients for Weighted Factors Composite Scores Predicting Board Scores

AFSC	$R^2$
Total Sample	.40775
30490	.61373
43290	.39614
73292	.43214
81191	.56502

### Correlational Analysis

Although the regression analysis treated in the preceding section indicated that results of promotion board deliberations cannot be satisfactorily explained by the weighted factors system, it was of considerable interest to analyze the individual factors of the system in terms of their relationship to the promotion board component. The rationale for this analysis was that ideally there should be a high correlation between these factors and the board component if these factors are reliable in the sense that they were consistently reflected in the promotion board scoring pattern. Also, if the promotion boards were consistent in judging the relative merits of the factor scores, then the magnitude of any particular subscore or factor correlation with the board score component would be expected to remain approximately the same across specialties. For instance, if Time-in-Grade scores correlate highly with the Promotion Board scores for one specialty, they should also correlate highly for the other specialties as well.

Table 5 summarizes the correlation coefficients of the factor scores with the Promotion Board score. Inspection of the table suggests a strong likelihood that promotion boards considered factors as differentially important across the specialties analyzed. For example, for the Communications-Electronics Systems Career Field (30490), the correlation coefficient for the Airman Performance Report score was .7460. The other correlation coefficients for this specialty were either relatively low or negative as in the case of the Time-in-Service score. For the Aircraft Maintenance Career Field (43290), the correlation coefficient for the Decoration score was the highest; for the Personnel Career Field (73293), the correlation coefficient for Airman Performance Report stood out; and for the Security Police Career Field

(81191), the correlation coefficient for Time-in-Grade was sizable.

It appeared that there were three distinct decision patterns related to the relative merits of the individual factors on the part of the promotion boards. There was only one apparent agreement: In three of the four specialties analyzed, Time-in-Service scores were negatively related to Promotion Board scores.

The implication is that the different specialties had different promotion policies. It is possible, but unlikely, that each of the boards considered only a single career field, so that a "board policy" as opposed to an "Air Force Specialty policy" could have been operating. In normal promotion board actions, however, all the candidates for a given Air Force Specialty are considered by a single board, and then that board moves on to consider additional specialties.

### Alternate Systems

The preceding analyses strongly implied that the weights as determined for grades E-4 through E-7 are not applicable for predicting promotion/non-promotion outcomes in the supergrades E-8 and E-9. It became evident that certain factors of the weighted factors system did not contribute to the predictive efficiency of the system. Time-in-Service, for example, had a negative correlation with the Promotion Board component in three of the four specialties analyzed. Furthermore, USAF Supervisory Examination scores were not available to the promotion boards when board scores were assigned; only the pass-fail information was known. Thus, this factor could not have contributed to the predictive efficiency of the weighted factors system when predicting promotion board outcomes. A passing grade on the USAF Supervisory Examination was a prerequisite

Table 5. Correlations Between Board Score and Factors of the Weighted Factors Composite

AFSC	Correlation between Board Score and Factor				
	USAFSE	DEC	TIS	TIG	APR
30490	.2349	.2026	-.3346	.0072	.7460 <sup>a</sup>
43290	.0455	.5474 <sup>a</sup>	-.0039	.2785	.0861
73293	.1369	.1975	-.2459	-.1533	.6219 <sup>a</sup>
81191	-.0959	.1997	.2371	.6394 <sup>a</sup>	.0613

<sup>a</sup>Highest correlation coefficient for specialty.

for eligibility for promotion; as far as the boards were concerned, everybody had a passing grade. No other indicator appeared in the selection folders of eligible airmen.

#### SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the extent to which the weighted factors system used for grades E-4 through E-7 would predict the same individuals for promotion to grades E-8 and E-9 as were actually promoted. The second major task was to investigate the effects of optimal weighting procedures in an attempt to maximize correspondence between the number of promotions predicted by the weighted factors system and the actual number of promotions in a particular specialty.

The following conclusions were reached based upon the analyses of this study:

1. The originally proposed weighted factors system, either with or without a board component, would have promoted a relatively small proportion of the individuals who were actually promoted. This inability of prediction of selection was statistically significant.

2. When ties were broken by Time-in-Grade scores, Airman Performance Report scores, and Decoration scores, Promotion Board scores agreed with the actual promotions with the exception of two cases. Two individuals who were not promoted had higher Promotion Board scores than those who were promoted.

3. The predictive efficiency of the weighted factors score for the Promotion Board score was relatively low, ranging from an  $R^2$  of .3962 to an  $R^2$  of .6137.

4. Correlations of the Promotion Board score with the various factors of the weighted factors system implied that there were at least three distinct patterns of promotion considerations for the

four specialties analyzed. For the Aircraft Maintenance Career Field, the Decoration score seemed to carry a heavier weight; for the Security Police Career Field, Time-in-Grade was the major factor; and for the Communications-Electronics Systems Career Field, Airman Performance Report scores seemed more important.

5. The Time-in-Service factor carried a negative weight, with the implication that the longer an individual was in the service, the lower his Promotion Board score appeared to be, all other scores being equal.

6. Inclusion of the USAF Supervisory Examination score in the weighted factors composite reduced the accuracy with which the system predicted actual promotions.

7. Although a sizable improvement was achieved in percentage overlap by increasing the relative contributions of the Promotion Board score and the Airman Performance Report variables and eliminating the USAF Supervisory Examination scores and Time-in-Service scores, considerable differences in percentage overlap among the specialties in the study still remained. There appears to be very little possibility of devising a single weighted factors system which will optimize the extent to which promotion board results are duplicated by the system simultaneously across a large number of specialties.

In summary, the weighted factors promotion system as originally proposed did not, in general, predict the same individuals for promotion as did the actual selection process. This lack of predictive power was statistically significant. If a weighted factors promotion system is to be implemented for grades E-8 and E-9, such factors as Time-in-Service scores and USAF Supervisory Examination scores should be eliminated, a board component should be included, and weights of the remaining factors should be altered in order to maximize the degree of agreement in promotion outcomes between the existing and the new system.

**APPENDIX II. SUPERINTENDENT AIR FORCE SPECIALTIES FROM WHICH SAMPLE WAS DRAWN**  
(Sequenced on Number of Cases in Original File)

Sequence Nr.	AFSC	Career Field	Selector Aptitude Index	Nr. in File	Nr. with USAFSE Score
1	43191	Aircraft Maintenance	M	2,684	2,406
2	70490	Administrative	A	1,305	1,032
3	64590	Supply	A	1,093	895
4	43590	Aircraft Maintenance	M	932	703
5	73293	Personnel	A	904	653
6	01090	First Sergeant		822	376
7	30190	Communications-Electronics Systems	E	726	646
8	30490	Communications-Electronics Systems	E	632	560
9	43290	Aircraft Maintenance	M	625	594
10	42190	Aircraft Accessory Maintenance	M	469	449
11	81191	Security Police	G	430	373
12	29190	Communications Operations	A	410	356
12	31692	Missile Electronic Maintenance	E	410	358
13	27392	Aerospace Control Systems Operations	G	409	345
13	75193	Education and Training	G	409	306
14	32290	Avionics Systems	E	408	377
15	30390	Communications-Electronics Systems	E	393	354
16	32390	Avionics Systems	E	316	269
17	42490	Aircraft Accessory Maintenance	M	302	237
18	43390	Aircraft Maintenance	M	301	266
19	99120	Recruiter		299	240
20	27290	Aerospace Control Systems	G	282	235
21	68790	Data Systems	G	281	249
22	30593	Communications-Electronics Systems	E	265	236
23	46290	Munitions and Weapons Maintenance		259	244

**APPENDIX III: AIRMAN PROMOTION SELECTION FACTORS AND POINTS**  
*Grades E-8 and E-9*

<b>Factor</b>	<b>Maximum Points</b>	<b>Percentage</b>
USAF Supervisory Examination (USAFSE) Score	90	19%
Time-In-Service (TIS) Score	40	8%
Time-In-Grade (TIG) Score	60	12%
Decoration (DEC) Score	25	5%
Airman Performance Report (APR) Score	135	26%
Promotion Board Score	150	30%
<b>Total</b>	<b>505</b>	<b>100%</b>

**Explanation of Factors**

The USAF Supervisory Examination will be administered annually.

Points for the USAFSE will be the actual percentile score obtained (in 5 point increments).

Time-in-Service will be computed by multiplying years of Total Active Federal Military Service by 2. Less than 6 months will count as 1 point; over 6 months will count a full year, 2 points. A cutoff score of 40 points, for 20 years of TAFMS, has been established.

Time-in-Grade will be computed at the rate of ½ point per month up to a maximum of 120 months, 60 points; 15 days or less will be dropped; 16 or more will count as a full month.

Decorations will be assigned points according to their order of precedence. The maximum number of points attainable is 25. Decorations will count for promotion regardless of the military service in which they were earned.

The Airman Performance Report score is obtained by multiplying the overall evaluation mean by 15. The mean is based on reports for a 5-year period prior to the eligibility date, not to exceed ten reports.

The Promotion Board score will be based on a review by the board that concentrates on those items not previously weighted; e.g., education level and efforts to improve self both in terms of formal education, technical knowledge, etc. Reduced selection folder will consist of Category A favorable communications, APR word picture, and pages 2 and 4 of the Air Force Form 7.

Unclassified  
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Personnel Research Division Lackland AFB, Texas 78236		2a. REPORT SECURITY CLASSIFICATION	
		2b. GROUP	
3. REPORT TITLE EXTENSION OF THE WEIGHTED AIRMAN PROMOTION SYSTEM TO GRADES E-8 AND E-9			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
5. AUTHOR(S) (First name, middle initial, last name) Koplyay, J.B.			
6. REPORT DATE January 1970		7a. TOTAL NO. OF PAGES 12	7b. NO. OF REFS 4
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S) AFHRL-TR-70-2	
b. PROJECT NO. 6323			
c. Task 632305		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT  This document has been approved for public release and sale; its distribution is unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Personnel Research Division Lackland AFB, Texas 78236	
13. ABSTRACT  The Weighted Airman Promotion System (WAPS), a system designed and implemented for E-4 through E-7 promotions, was considered for application at the E-8 and E-9 levels. A sample of 1,388 cases was selected from among airmen eligible for promotion to E-8 in the FY 1969 promotion cycle; four career fields in each of four selector aptitude areas were represented. Weighted factors composite scores, including United States Air Force Supervisory Examination, Time-in-Grade, Time-in-Service, Decoration, and Airman Performance Report scores, were computed for all cases in the sample. These composite scores were computed both with and without a Promotion Board score. The derived scores were then rank-ordered to determine the accuracy with which the composite scores predicted the actual promotion outcomes. Although there was some overlap between the predicted and actual promotions, the predictions were not precise enough to encourage operational use of the system with the weights as established in the WAPS. In a series of regression analyses, optimal weights were computed for the same factors. Again, however, the predicted promotions did not correspond sufficiently with the actual promotions to demonstrate feasibility of the system. Further, there was evidence that differential promotion policies were operating in the promotion decisions across career fields. It was concluded, therefore, that a weighted factors promotion system appropriate for use at the E-8 and E-9 levels must include as yet unidentified variables and possibly different equations for various career fields.			